Smart Grid Interoperability Knowledge Base
Vision Statement

May 25, 2009

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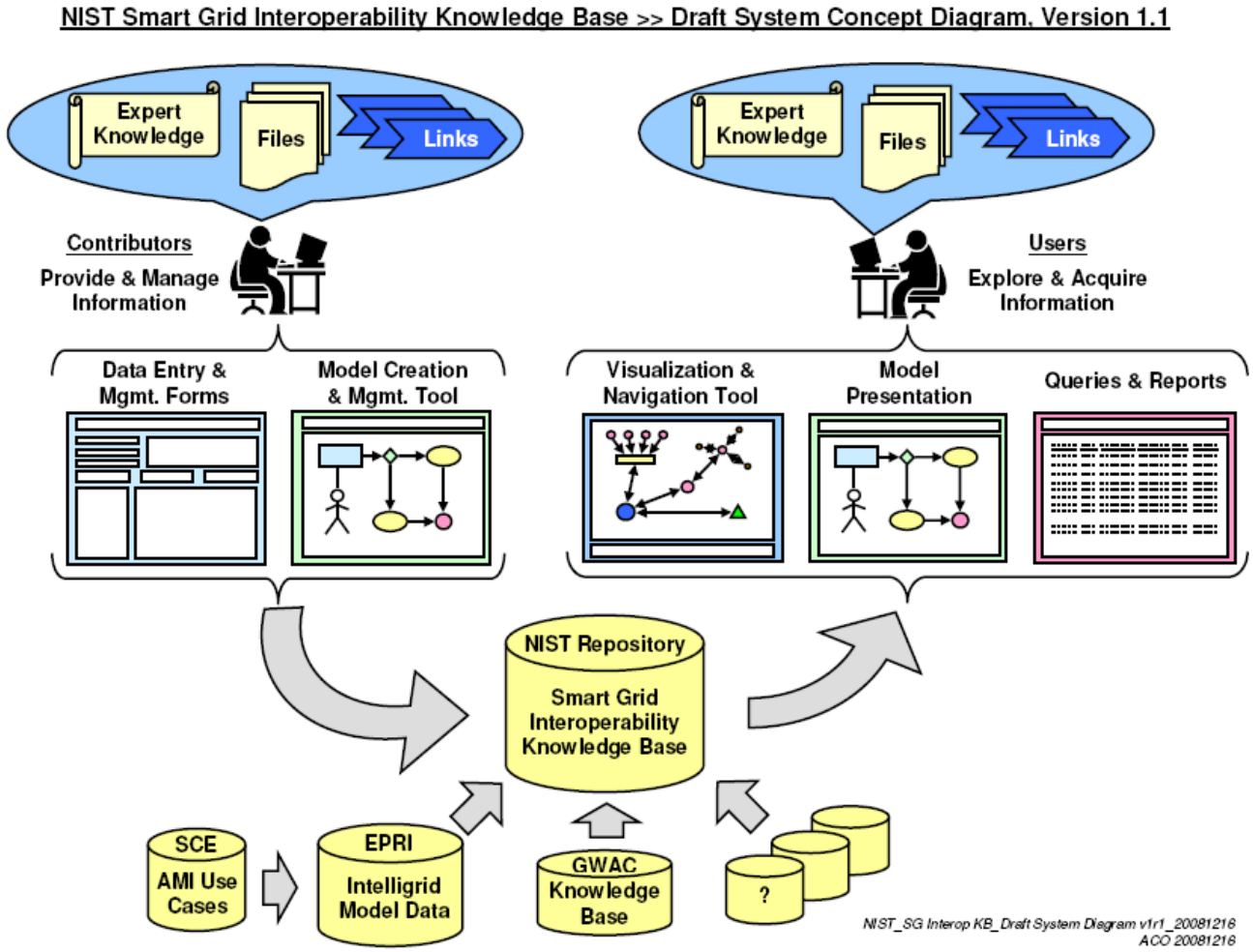
1 Introduction

This document describes the overarching vision that is guiding development and implementation of the NIST Smart Grid Interoperability Knowledge Base (hereafter referenced with the acronym "IKB"). Details of the IKB project approach are further described in a separate document, titled "*NIST Smart Grid Interoperability Knowledge Base Development and Implementation Plan*".

2 Background

NIST launched the Smart Grid Interoperability Program (SGIP) to serve as its vehicle for fulfilling the responsibilities assigned to NIST in the Energy Independence and Security Act of 2007. The IKB will be a key program resource that provides valuable, trusted, multi-faceted information to the very broad community of Smart Grid stakeholders. The figure below portrays the IKB concept.



3 Guiding Principles

Five guiding principles are particularly important for the purpose of IKB planning:

1. Successful development and maintenance of the Smart Grid Interoperability Framework will require extensive collaboration among the many, diverse members of the Smart Grid Community.
2. Successful collaboration within the Smart Grid Community will require an effective and efficient Collaboration Framework.
3. The IKB will be at the core of NIST's Collaboration Framework. This means the IKB will be the primary channel through which collaborators will compile, organize, explore, analyze, update, and share their latest facts and opinions regarding Smart Grid interoperability. NIST envisions the IKB employing a variety of web-based technologies and methods to achieve effective collaboration support.
4. The IKB will be the primary public repository for information about NIST's Smart Grid Interoperability Framework. This means the IKB will provide its users with effective tools for compiling, organizing, exploring, and visualizing information about the elements, interactions, and governing principles of the Interoperability Framework. NIST envisions the IKB employing a variety of web-based technologies and methods to achieve effective framework presentation.
5. The IKB will portray the Smart Grid Interoperability Landscape, Assessment, and Roadmap in a variety ways that will serve the diverse needs and perspectives of the Smart Grid Community.

4 Approach

NIST's will develop and implement the IKB by employing an "agile development" approach that involves a progressive, evolutionary sequence of system "builds". Through this approach, the first build will deliver to IKB users a limited set of useful capabilities within a relatively short time, followed by a series of increasingly enhanced builds that will ultimately achieve the full IKB vision. Each build will be designed and implemented to fulfill a set of requirements developed for that particular build. After the first build, the requirements for each subsequent build will encompass the requirements of the prior build plus a substantial set of new requirements (with adjustments based on lessons learned). The succession of system builds will allow the IKB design to evolve in concert with the objectives of the NIST program and with the ever-changing domain of information relevant to Smart Grid interoperability.

5 Timeline

NIST envisions implementing the IKB over the next 18 months. The main activities of the IKB development project are listed below with their approximate timing.

1. Initiate IKB Development Project (months 1 - 2);
2. Develop System Build Requirements (months 2 - 12);
3. Design System Builds (months 3 - 15);

4. Assemble System Builds (months 3 - 16);
5. Test System Builds (months 5 – 18)
6. Roll Out System Builds (months 6 - 18);
7. Complete IKB Development Project (month 18).

6 IKB Requirements

Effective discovery, specification, management, and fulfillment of Smart Grid stakeholder requirements is critical to the success of the IKB. The key challenge will be for the IKB to readily grow and transform as the NIST program and the Smart Grid evolve from their current early stages of development to more mature stages. Consequently, the IKB requirements specified at any given time will be developed through a sustained, structured process that will assure timely evolution of valued IKB capabilities and attributes.

6.1 Stakeholders

The IKB will be an important information resource for the many distinct groups of Smart Grid stakeholders. Requirements for the IKB will be identified and characterized in terms of the groups' respective relationships with Smart Grid Interoperability, their IKB information needs, and their roles (if any) as providers and/or managers of IKB content. Stakeholder groups will include (but not be limited to):

> utilities, consumers, ISOs, RTOs, regulators, policy-makers, standards organizations, system architects, energy service providers, hardware & software suppliers, telecommunications carriers, industry groups, government labs, academics, system integrators, financial institutions, industry & mass media,…

Along with serving the diverse needs and roles of the Smart Grid stakeholders, the IKB must also support the needs of the IKB's system administrators, operators, technical support team, and user support team.

6.2 IKB Application Frameworks

Starting with the first system build, the IKB will fulfill Smart Grid stakeholders' specified functional and non-functional requirements supporting three application frameworks:

6.2.1 Collaboration Framework

The IKB will employ a variety of web-based technologies and methods to enable effective collaboration among the stakeholders who develop and manage the Smart Grid Interoperability Framework. Collaborators will use the IKB as their principal common resource as they compile, organize, explore, analyze, update, and share their latest questions, opinions, facts, and recommendations regarding Smart Grid interoperability.

6.2.2 Interoperability Framework

The IKB will be the primary public repository for information about the Smart Grid Interoperability Framework. Users will employ a variety of web-based technologies and methods for compiling, organizing, exploring, and visualizing information about the framework's elements, interactions, and governing principles. Further, the IKB will portray the Smart Grid Interoperability Landscape, Assessment, and Roadmap via "living" views that dynamically adapt to changes in IKB content. These views will be produced in a variety ways that will serve the diverse needs and perspectives of the Smart Grid community.

6.2.3 Management Framework

The IKB Support Team (comprising system administrators, operators, technical support staff, help-desk, etc.) will employ a well-integrated framework of resources for managing IKB availability, integrity, and performance. As the IKB evolves from one build to the next, the Support Team's requirements for this framework must be understood early, reviewed often, and updated as needed.

6.3 Functional Requirements

Functional requirements specify the functions a system is expected to perform and the expected behavior of the system as it performs those functions. The IKB's functional requirements include the intended attributes and relationships of the IKB's inputs, resident data, internal processes, and outputs.

It is important to here note NIST's intention that user interactions with IKB functions will, to the greatest extent possible, guide the users toward employing common methods and uniform semantics whenever they communicate information regarding Smart Grid interoperability.

6.3.1 Content Requirements

The subject of Smart Grid Interoperability is broad, complex, and dynamic; thus, it is reasonable and essential to expect that the IKB will be correspondingly broad, complex, and dynamic. The IKB will primarily function as an advanced and highly adaptive content management system that effectively absorbs, retains, and presents the information deemed useful by the stakeholders.

6.3.1.1 Subject Matter

The IKB requirements development process will begin with a preliminary, high-level taxonomy which will provide a uniform framework for initial discovery and documentation of valued subject matter categories. As the process progresses, the taxonomy will be reviewed and, when necessary, adjusted to accommodate content categories and attributes that were not

originally anticipated. The preliminary IKB subject matter taxonomy will encompass (at a minimum) the following categories of information relevant to grid interoperability:

- entities (people, organizations, systems, devices...);
- technologies (standards, protocols, processes, practices...);
- use cases and their respective domains (markets, operations, service providers, bulk generation, transmission, distribution, and customer);
- applications and their respective use cases;
- interactions and their respective requirements:
  - intra-domain / inter-domain;
  - intra-application / inter-application;
- information objects (measurement, event, status, command, setting, request, price, commitment, program code, identity, authentication, authorization...);
- policies & regulations (security, privacy, financial, environmental, safety, reliability…);
- Smart Grid and general interoperability development activities;
- interoperability test and certification information:
  - requirements
  - resources
  - activities
  - results
- the relationships between all of the above;

6.3.1.2 Content Types

Given the breadth, depth, and complexity of expected IKB content, it is reasonable and essential to anticipate that the IKB will absorb, manage, and present its content in many different forms. Further, IKB content pertaining to any particular subject can - and probably will - come in more than one form (often in several forms). Common forms of content (both static and active) that could be required in the IKB include documents, databases, email archives, HTML files, raw data files, program code, UML models, lists, tables, spreadsheets, calendars, schedules, forms, charts, diagrams, illustrations, presentation slides, audio recordings, photographs, videos, animations, …, etc. Required content types will be identified and characterized by associating the required

subject matter categories with the types of content that stakeholders will most likely use and value for those categories.

6.3.1.3 Information Quality

Information quality describes the degree to which the IKB's content, organization, and functions provide valued information to IKB users. The value derived from the information is a largely subjective measure, is viewed from diverse user perspectives, and is characterized by multiple dimensions. The information quality dimensions specified for each IKB build should include accessibility, accuracy, authority, believability, completeness, consistency, interpretability, objectivity, relevance, timeliness, and transparency.

6.3.2 User Interfaces and Tools

The large majority of IKB users will be contributors and/or consumers of IKB content. All users in these two main categories will share the need for a number of common interfaces and tools that will enable their productive use of the IKB. Further, contributors and consumers from some stakeholder groups will require more specialized tools to support their respective needs. Finally, the IKB Support Team - comprising the IKB's system administrators, operators, techical support staff, and user support personnel - will require an appropriate suite of system monitoring and management utilities.

Currently anticipated requirements for user interfaces and tools are further described in the following subsections.

6.3.2.1 All Users

NIST expects that virtually all IKB users will share requirements for a common set of interfaces and tools supporting fundamental functions including (but not limited to):

- access management;
- conditional content search;
- content copy / export with appropriate versioning;
- glossary (including all acronyms);
- thesaurus;
- directories;
- calendars;
- web link library;
- digital content library;

- electronic forums;
- content update notification;

6.3.2.2 Content Contributors

Following initial incorporation of established information sets into the IKB (the EPRI Intelligrid Use Case Library, for example), further development of the IKB will rely on a large and diverse community of expert contributors who will add, update, and remove information describing the knowledge and opinions that they each wish to share.

NIST expects that IKB content contributors and managers will need a suite of online forms and UML (Unified Modeling Language) modeling tools. Online forms will be needed for text-based information entry (including hyperlinks) and file imports (documents, spreadsheets, diagrams, presentations, images, …) pertaining to all categories of IKB content. The IKB should also support user configurable utilities for data migration and for data feeds from external systems (static and dynamic). Modeling tools will provide contributing experts a standard way to visually portray all of the technical details needed to fully characterize any type of Smart Grid process and its associated interaction(s).

6.3.2.3 Content Consumers

IKB users who seek information pertaining to Smart Grid interoperability, will need interfaces and tools that enable them to readily explore, interpret, and acquire IKB content. NIST anticipates providing a type of graphical visualization tool that flexibly accommodates users' diverse interests and perspectives; supports multiple visualization modes; clearly maps the relationships between information objects; and, dynamically adapts to the ever-changing body of content in the IKB. Users seeking a detailed technical understanding of Smart Grid processes and/or interactions will be supported by one or more tools that enable them to fully access, view, and download any UML model data residing in the IKB. Knowledge seekers will also be provided with form-based interfaces for running queries and reports against the data in the IKB.

6.3.2.4 Interoperability Framework Collaborators

The Smart Grid Interoperability Framework will be developed, extended, and managed by a diverse community of collaborating stakeholders who will use the IKB as both consumers and contributors of information. Several of the functions described above in Section 6.3.2.1 will promote effective and efficient

collaboration among those stakeholders. Where it is possible and useful to do so, the IKB will provide a framework of additional tools and information resources that will enable collaborative development of documents and system models.

6.3.2.5 IKB Support Team

The IKB Support Team - comprising system administrators, operators, techical support staff, and user support personnel - ensures that the production instance or the IKB (the system that is seen and used by the public) operates at satisfactory levels of availability and performance while providing its intented services.

To perform their work effectively, the Support Team will require tools for a variety of system management functions. Best practices in system management typically employ proven tools and methods for:

- real-time and historical performance measurement;
- job control;
- security administration;
- configuration management;
- change control and tracking;
- data migration tools;
- error detection, logging, and troubleshooting
- trouble reporting and tracking;
- data protection;
- etc.

6.4 Non- Functional Requirements

Non-functional requirements specify the qualities that a system is expected to exhibit when it is used for its intended purpose. These qualities can be further distinguished as being either execution attributes or evolution attributes which are described further in the following sub-sections.

6.4.1 Execution Attributes

The IKB's execution attributes will be manifested during system operation and will directly affect IKB users, system operators, and interacting external systems. At a minimum, the execution attributes specified for each IKB build will include security, accessibility, usability, process capacity, information capacity, communications capacity, response time, and availability.

6.4.2 Evolution Attributes

The IKB's evolution attributes are a product of system structure and generally affect the activities performed by system designers, installers, testers, and managers. At a minimum, the evolution attributes specified for the IKB will include affordability, scalability, extensibility, supportability, securability, testability, IT compatibility, openness, interoperability, resilience, and portability.